REMARKS

Applicant respectfully requests consideration of the present application, as amended.

Summary of Office Action

Claims 1-19 and 37-39 are pending.

The disclosure was objected to.

The claim numbering was objected to.

Claims 1-3, 8-10, and 15 were rejected under 35 U.S.C. § 103 as being unpatentable over U.S. Patent No. 5,359,236 of Giordano ("Giordano") in view of U.S. Patent No. 4,789,819 of Nelson ("Nelson") in further view of U.S. Patent No. 5,287,292 of Kenny, et al. ("Kenny").

Claims 4-7, 11-14, and 16-19 were rejected under 35 U.S.C. § 103 as being unpatentable over Giordano in view of Nelson in further view of Kenny and U.S. Patent No. 5,077,491 of Heck, et al. ("Heck").

Examination of claims 37-39 has been deferred in view of applicant's attempt to provoke an interference.

Summary of Amendments

Claims 1-19 were amended. Applicant respectfully submits support for the amendment to claims 1-19 is found in the drawings and the specification including the claims as originally filed. Applicant respectfully submits that the amendments to the claims do not add new matter.

Accompanying this Amendment is (1) a document entitled Request to Approve Drawing Changes and (2) a photocopy of Figure 7 of the drawings

with proposed changes marked in red. Applicant respectfully requests the Examiner to approve the proposed changes to Figure 7.

The proposed change to Figures 7 changes the reference character of the programmable thermal sensor from "110" to "100." Applicant respectfully submits that the change is necessary for consistency with reference to Figure 7 in the specification.

Applicant respectfully submits that support for the proposed change to Figure 7 is found, for example, at pages 23-24 of the specification. Applicant respectfully submits that the proposed change to Figure 7 does not add new matter.

Response to objection to the specification

The specification was objected to due to informalities. In particular, the Examiner stated: "on page 23, reference 'programmable thermal sensor 100' is not in Fig. 7." (1/9/97 Office Action, p. 2).

As stated above, applicant has submitted a Request to Approve Drawing Change for Figure 7 that changes the reference characters for the programmable thermal sensor from "110" to "100." Thus Figure 7, as amended, illustrates the "programmable thermal sensor 100."

Applicant respectfully submits the Examiner's objection to the specification has been overcome.

Response to objection to claim numbering

The Examiner has indicated that claims 20-22 added in the Preliminary Amendment filed on June 6, 1996 were improperly numbered. (1/9/97 Office Action, p. 2)

Applicant respectfully submits that the numbering of the claims was an oversight. The parent application was filed with claims 1-36. Claims 1-19 were elected in response to a restriction requirement. Claims 20-36 were subsequently canceled by amendment. The numbering of any new claims should have started with 37, not 20. Applicant apologizes for the oversight.

Given that the Examiner has properly renumbered the claims submitted as new claims 20-22 in the Preliminary Amendment filed on June 6, 1996 to claims 37-39, applicant respectfully submits that the claims are now properly numbered. Thus no objection to claim numbering remains.

Response to 35 U.S.C. § 103 rejections

Claims 1-3, 8-10, and 15 were rejected under 35 U.S.C. § 103 as being unpatentable over various combinations of Giordano, Nelson, and Kenny.

Applicant respectfully submits that in order to establish a prima facie case of obviousness three basic criteria must be met. 1) There must be some suggestion or motivation either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings; 2) There must be reasonable expectation of success; and 3) The prior art reference (or references) when combined must teach or suggest all of the claim limitations. Furthermore, the teaching or suggestion to make the claimed combination and the

reasonable expectation of success must be found in the prior art, not in applicant's disclosure. (MPEP § 2143 citing In re Vaeck, 20 USPQ2d 1438 (Fed. Cir. 1991).

Applicant respectfully submits that claims 1-19 are patentable in view of the cited references. Without addressing 1) motivation to combine, or 2) workability of such a combination, applicant respectfully submits that the cited references do not teach or suggest all of the claim limitations.

With respect to claim 1, applicant respectfully submits that *none of the cited references, alone or combined, teaches or discloses a method for detecting a threshold temperature in an integrated circuit including the step of receiving at least one programmable input specifying a value corresponding to a threshold temperature for the integrated circuit.*

Giordano includes a disclosure of a thermal sensor circuit. The thermal sensor circuit of Giordano generates a signal when a predetermined threshold temperature is reached. In particular, Giordano discloses a means of varying a temperature sensitive VBE to vary the rate of change of conduction of a transistor for small temperature variations about a critical temperature. (Giordano, col. 5, line 33 thru col. 6, line 4). Applicant submits that the critical temperature is established at the time of manufacture through the characteristics of circuit components such as Q1 and R2 (see col. 1, line 26 thru col. 2, line 2 referring to Fig. 1A; Fig. 4; Fig. 2 as a simplified representation of Fig. 4; col. 2, line 46 thru col. 3, line 39). Applicant thus respectfully submits that *the thermal sensor circuit of Giordano is not programmable. Thus Giordano does not teach or disclose a method for detecting a threshold temperature in an integrated circuit including the step*

of receiving at least one programmable input specifying a value corresponding to a threshold temperature for the integrated circuit.

Nelson includes a disclosure of a voltage reference circuit including a Brokaw Cell band-gap reference circuit. The voltage reference circuit includes breakpoint compensation to adjust the temperature coefficient of the Brokaw cell in order to provide a reference voltage substantially independent of temperature. (Nelson, col. 2, lines 19-26 and 52-65; Figs. 3-5). Nelson further discloses a thermal shutdown circuit for the voltage reference circuit as incorporated in a voltage regulator. (Nelson, col. 6, lines 46-55; Fig. 4). A driver circuit limits the power output of the voltage regulator. The thermal shutdown circuitry is coupled to the voltage regulator to control the driver circuit to limit the power output of the voltage regulator when a predetermined temperature is exceeded. (Nelson, col. 7, lines 1-19). The predetermined temperature is established by the fixed value of the components of the Nelson circuitry. (see Nelson, Fig 4.; col. 6, line 39 thru col. 7, line 26). Applicant respectfully submits that *Nelson's thermal shutdown circuitry is also not programmable. Thus Nelson does not teach or disclose a method for detecting a threshold temperature in an integrated circuit including the step of receiving at least one programmable input specifying a value corresponding to a threshold temperature for the integrated circuit.*

With respect to Kenny, the Examiner has stated:

> Regarding a varying threshold voltage detection, Kenny discloses an integrated circuit to detect programmable threshold in order to sense the temperature of a CMOS integrated circuit. When the programmable threshold value is detected (predetermined temperatures), the CPU speed is decreased or increased accordingly.

(1/9/97 Office Action, p. 4)

Applicant respectfully traverses the Examiner's characterization of Kenny. Kenny includes a disclosure of a heat regulator for integrated circuits. The temperature of the integrated circuit is either 1) measured directly with a temperature monitor, or 2) indirectly estimated from a measure of the activity of the integrated circuit. (Kenny, col. 1, line 51 thru col. 2, line 2). Kenny does not teach or disclose a "programmable threshold in order to sense the temperature of a CMOS integrated circuit."

Applicant respectfully submits that the direct measuring temperature monitor taught by Kenny is *not programmable*. Referring to Figure 5, the temperature is measured by using a voltage divider including a temperature dependent resistor (501). The voltage divider provides a signal 505 to a power use regulator 502. When signal 505 reaches a trigger value, the power use regulator activates (Kenny, col., 9, lines 40-45). *Thus Kenny's "direct method" does not teach or disclose a method for detecting a threshold temperature in an integrated circuit including the step of receiving at least one programmable input specifying a value corresponding to a threshold temperature for the integrated circuit.*

With respect to the "indirect method" of measuring temperature, applicant points out that the indirect method *does not actually measure temperature.* Instead, counters are used to accumulate a count corresponding to the length of time that the CPU is operating at various frequencies. (Kenny, col. 5, line 42 thru col. 6, line 22). The counter increments when the CPU is operating at one frequency and decrements when the CPU is operating at another frequency. If the counter reaches a threshold value, a regulating

signal is generated to force the CPU to a slower clock speed. (Kenny, col. 5, lines 58 thru col. 6, line 5).

Even if different "threshold values" can be used, the threshold values change the length of time that the CPU operates at higher clock frequencies regardless of the temperature of the CPU. Given that Kenny's threshold value is independent of temperature, the value cannot correspond to a threshold temperature for the integrated circuit. *Thus Kenny's "indirect method" does not teach or disclose a method for detecting a threshold temperature in an integrated circuit including the step of receiving at least one programmable input specifying a value corresponding to a threshold temperature for the integrated circuit.*

Thus applicant respectfully submits that *none of the cited references, alone or combined, teaches or discloses a method for detecting a threshold temperature in an integrated circuit including the step of receiving at least one programmable input specifying a value corresponding to a threshold temperature for the integrated circuit.*

In contrast, amended claim 1 includes the language:

> 1. *A method for detecting a threshold temperature in an integrated circuit comprising the steps of:*
>
> • • •
>
> *receiving at least one programmable input specifying a value corresponding to a threshold temperature for the integrated circuit;*
> generating a sensing voltage that varies substantially linearly with the temperature of the integrated circuit;
>
> • • •

(Claim 1, as amended)(*emphasis added*).

Applicant respectfully submits that the same arguments presented above with respect to method claim 1 similarly apply to apparatus claims 8

and 15. In particular, none of the cited references, alone or combined, teaches or discloses an apparatus for detecting a threshold temperature in an integrated circuit including at least one programmable input for receiving a value corresponding to a threshold temperature of the integrated circuit.

In contrast, claims 8 and 15 include the language:

> 8. *An apparatus for detecting a threshold temperature in an integrated circuit comprising:*
>
> • • •
>
> *at least one programmable input for receiving a value corresponding to a threshold temperature of the integrated circuit;*
>
> • • •

(Claim 8, as amended)(*emphasis added*).

> 15. *An apparatus for detecting a threshold temperature in an integrated circuit comprising:*
>
> • • •
>
> *at least one programmable input receiving a value corresponding to a threshold temperature for the integrated circuit;*
>
> • • •

(Claim 15, as amended)(*emphasis added*).

Moreover, applicant respectfully submits that *none of the references alone or combined, teaches or discloses a method for detecting a threshold temperature in an integrated circuit including the step of scaling a sensing voltage in accordance with a value corresponding to a programmable threshold temperature, wherein the comparison voltage is substantially equal to a voltage reference when the temperature of the integrated circuit is substantially the same as the threshold temperature.*

With respect to <u>Giordano</u>, the Examiner has stated:

> Giordano also discloses that the integrated thermal sensor includes a current source to generate the turn-on (or control) voltage (signal) which is increased linearly as a function of increasing temperature (col

> 3, lines 2-5, col 5 and Figs. 2 & 4). *Thus this control voltage V14 is scaling to proportionally and linearly with increasing temperature. Additionally to the scaling of the sensing voltage of Giordano...*

(1/9/97 Office Action, pp. 3-4)(*emphasis added*).

Applicant respectfully traverses the Examiner's characterization of Giordano. Applicant respectfully submits that there is no "scaling" in Giordano as proposed by the Examiner. Figure 2 is a simplification of the circuitry of Figure 4. Although the voltage at node 14 increases as a result of increases in current from current source 10, there is no "scaling of the sensing voltage." As best as applicant understands the remark, the Examiner is attempting to analogize the control voltage at node 14 of Giordano with applicant's sensing voltage. Applicant respectfully submits that the voltage at node 14 cannot represent both a sensing voltage and a scaled sensing voltage.

The control voltage at node 14 is produced as a result of current from current source 10 passing through resistor R2. Without R2, there is no control voltage at node 14. Although the control voltage at node 14 is related to the value of resistor R2, resistor R2 is fixed in value at the time of manufacture. Resistor R2 does not scale the control voltage. To the contrary, resistor R2 produces the control voltage. Applicant therefore respectfully submits that there is no "scaling of the sensing voltage of Giordano" as proposed by the Examiner.

Applicant respectfully submits that the thermal sensor of Giordano is not programmable. As a result, Giordano does not teach or disclose scaling the sensing voltage in accordance with the value corresponding to a programmable threshold temperature. *Thus Giordano does not teach or disclose a method for detecting a threshold temperature in an integrated*

circuit including the step of scaling a sensing voltage in accordance with a value corresponding to a programmable threshold temperature, wherein the comparison voltage is substantially equal to a voltage reference when the temperature of the integrated circuit is substantially the same as the threshold temperature.

With respect to Nelson, the Examiner has stated:

> Nelson also discloses a scaling factor so as to obtain an output voltage with normally zero temperature dependence (col 1).

(1/9/97 Office Action, p. 4)

Applicant respectfully submits that the Examiner's own assessment of Nelson controverts what is claimed by applicant. In particular, the scaling performed by Nelson is performed to ensure an output voltage with zero temperature dependence. Applicant respectfully refers the Examiner to applicant's claim language.

For example, refer to any of claims 1, 8, or 15. Note that applicant's sensing voltage varies substantially linearly with the temperature of the integrated circuit. The voltage reference, however, is substantially independent of temperature. The sensing voltage is scaled in accordance with a value corresponding to a threshold temperature of the integrated circuit to generate a comparison voltage. The comparison voltage is substantially equal to the voltage reference when the temperature of the integrated circuit is substantially equal to the threshold temperature. Thus applicant's scaled sensing voltage (i.e., the comparison voltage) varies with the temperature of the integrated circuit. If anything, Nelson *teaches away*

from scaling a sensing voltage to generate a comparison voltage that varies with temperature.

Nelson's predetermined thermal shutdown temperature is established by the fixed value of the components of the Nelson circuitry. (see Nelson, Fig 4.; col. 6, line 39 thru col. 7, line 26). As discussed above, *Nelson's thermal shutdown circuitry is not programmable.* Given that Nelson does not teach or disclose programmable thermal shutdown circuitry, applicant respectfully submits that *Nelson does not teach or disclose a method for detecting a threshold temperature in an integrated circuit including the step of scaling a sensing voltage in accordance with a value corresponding to a programmable threshold temperature, wherein the comparison voltage is substantially equal to a voltage reference when the temperature of the integrated circuit is substantially the same as the threshold temperature.*

With respect to Kenny, applicant maintains that only the "direct" method measures temperature. The "direct" method, however, does not provide for programmable threshold temperatures. The threshold temperature is determined at the time of manufacture. Although the "indirect" method provides for programmable thresholds, these thresholds are merely indicate how long the CPU can operate at various clock frequencies - *not the temperature of the CPU.* The indirect method does not even measure temperature. The indirect method does not provide a sensing voltage that varies with the temperature of the CPU. Clearly, if there is no sensing voltage there is no scaling of the sensing voltage. Thus applicant respectfully submits *Kenny does not teach or disclose a method for detecting a threshold temperature in an integrated circuit including the step of scaling*

the sensing voltage in accordance with a value corresponding to a programmable threshold temperature, wherein the comparison voltage is substantially equal to a voltage reference when the temperature of the integrated circuit is substantially the same as the threshold temperature.

In contrast, claim 1 includes the language:

> 1. A method for detecting a threshold temperature in an integrated circuit comprising the steps of:
>
> generating a voltage reference that is substantially independent of a temperature of the integrated circuit;
>
> receiving at least one programmable input *specifying a value corresponding to a threshold temperature for the integrated circuit;*
>
> *generating a sensing voltage that varies substantially linearly with the temperature of the integrated circuit;*
>
> *scaling the sensing voltage in accordance with the value to generate a comparison voltage, wherein the comparison voltage is substantially equal to the voltage reference when the temperature of the integrated circuit is substantially the same as the threshold temperature;* and
>
> generating a signal when a difference between the comparison voltage and the voltage reference indicates the integrated circuit has attained said threshold temperature.

(Claim 1, as amended)(*emphasis added*).

With respect to apparatus claim 8, applicant respectfully submits that the arguments presented above with respect to claim 1 similarly apply. In particular, none of the cited references, alone or combined, teaches or discloses an apparatus for detecting a threshold temperature in an integrated circuit including temperature sensing means for generating a sensing voltage, the temperature sensing means scaling the sensing voltage in accordance with a value corresponding to a programmable temperature threshold to generate a comparison voltage, wherein the comparison voltage is

substantially equal to the voltage reference when the integrated circuit attains the threshold temperature.

In contrast, claim 8 includes the language:

> 8. *An apparatus for detecting a threshold temperature in an integrated circuit comprising:*
>
> voltage reference means for generating a voltage reference substantially independent of a temperature of the integrated circuit;
>
> at least one programmable input for *receiving a value corresponding to a threshold temperature of the integrated circuit;*
>
> *temperature sensing means for generating a sensing voltage wherein the sensing voltage varies substantially linearly with the temperature of the integrated circuit, the temperature sensing means scaling the sensing voltage in accordance with the value to generate a comparison voltage, wherein the comparison voltage is substantially equal to the voltage reference when the integrated circuit attains the threshold temperature;* and
>
> comparison means coupled to the temperature sensing means and the voltage reference means, wherein the comparison means generates a signal when the comparison voltage exceeds the voltage reference to indicate the integrated circuit temperature attained the threshold temperature.

(Claim 8, as amended)(*emphasis added*)

With respect to claim 15, applicant respectfully submits that the cited references do not teach or disclose an apparatus for detecting a threshold temperature in an integrated circuit including a voltage divider wherein the voltage divider scales Vbe in accordance with a value corresponding to a threshold temperature to generate a comparison voltage, wherein the comparison voltage is substantially equal to the voltage reference when the temperature of the integrated circuit is substantially equal to the threshold temperature.

In contrast, claim 15 includes the language:

15. An apparatus for detecting a threshold temperature in an integrated circuit comprising:

a bandgap reference circuit providing a voltage reference substantially independent of a temperature of the integrated circuit;

a bipolar transistor providing a base-to-emitter voltage (Vbe) as a sensing voltage, wherein the sensing voltage varies substantially linearly with the temperature of the integrated circuit;

at least one programmable input *receiving a value corresponding to a threshold temperature for the integrated circuit;*

a voltage divider coupled to the bipolar transistor, *wherein the voltage divider scales Vbe in accordance with the value to generate a comparison voltage, wherein the comparison voltage is substantially equal to the voltage reference when the temperature of the integrated circuit is substantially equal to the threshold temperature;* and

a comparator providing a signal when a difference between the comparison voltage and the voltage reference indicates that the threshold temperature has been attained.

(Claim 15, as amended)(*emphasis added*)

In view of the arguments presented above, applicant respectfully submits claims 1, 8, and 15 are patentable under 35 U.S.C. § 103 in view of the cited references.

With respect to the rejection of claims 4-7, 11-14, and 16-19, applicant submits all of claims 4-7, 11-14, and 16-19 are dependent claims. If an independent claim is nonobvious under 35 U.S.C. § 103, then any claim depending therefrom is nonobvious. (*see, e.g.,* MPEP §2143.03 citing In re Fine, 5 USPQ2d 1596 (Fed. Cir. 1988).

Given that claims 2-7 depend from claim 1, claims 9-14 depend from claim 8, and claims 16-19 depend from claim 15, applicant respectfully submits that claims 2-7, 9-14, and 16-19 are likewise patentable under 35 U.S.C. § 103 in view of the references cited by the Examiner.

Thus applicant respectfully submits that the rejections under 35 U.S.C. § 103 have been overcome.

Conclusion

Applicant respectfully submits that in view of the amendments and arguments set forth herein, the applicable rejections and objections have been overcome. Accordingly, claims 1-19, as amended, should be found to be in condition for allowance.

An Information Disclosure Statement accompanies this Amendment.

If a telephone conversation would facilitate resolving any outstanding issues, the Examiner is invited to contact the undersigned at (503) 684-6200.

If there are any additional charges associated with this communication, please charge Deposit Account No. 02-2666.

Respectfully submitted,

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